In what form can 'live electronic music' live on?

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In 1991 I wrote a short article comparing three 'live electronic' ensembles based in the UK and active in the late 1960s and 1970s (one into the 1980s) (Emmerson 1991). It was only in the final stages of preparation of this paper for presentation at the EMS05 conference in Montreal that I realised that the death of Hugh Davies on 1 January 2005 meant that a key member of each of the three ensembles was no longer with us. This article is thus dedicated to Barry Anderson (1935–1987, founder and director of the West Square Electronic Music Ensemble), Tim Souster (1943–1994, co-founder of Intermodulation) and Hugh Davies (1943–2005, founder member of Gentle Fire). The fact that they can no longer describe, elucidate and explain the repertoire that they created is directly pertinent to this paper. While its practitioners must inevitably (though hopefully not so prematurely) move on, as we celebrate Mozart's 250th birthday with performances of the vast majority of his compositions, we must ask 'in what form live electronic music can live on'.

1. ARCHIVE AND PRESERVATION

The archiving and preservation of electroacoustic music is now well established for fixed format ('tape') works. There has been a variety of formats over the years, from vinyl and analogue tape, through early (and unwieldy) digital tape formats, to CDs and hard discs. The limited longevity of formats has two components: the deterioration of the storage medium itself and the availability of suitable playback machines to allow archiving to new formats. Broadly speaking, transcription standards have become (pretty well) established and substantial progress made in creating digital archives of analogue works.[1] Furthermore, lessons have been learnt such that further archiving may be better automated from current formats.

The same cannot be said by a long way for 'live electronics'. The problem of archiving and preservation has several dimensions. The longevity of the original performance technology has often been very limited; maintaining devices in working order is now a specialist occupation, possibly requiring non-standard components to be custom built. Performance practice knowledge is fading; analogue instruments were performed in a very different way than their digital successors and, in addition, the interpretation of scores was often very idiosyncratic to the performer or group. This relates directly to the nature of many live electronic scores (where they existed). What we have left today may be incomplete and unreliable, modified in performance at the time, maybe inconsistently. Even when the original performers are available, memory itself can be unreliable and the greatest care must be taken to treat such evidence as one source of many.

Of course, as with any oral tradition, the archiving function has as its origin a 'preservation of results', a recordings archive allowing us to glimpse a period, a genre and its performers (as with earlier vernacular and folk tradition preservation). But what of *performing* such works again today? Some works (more than others) suggest that their composers and original performers *hoped* for a future existence for their work.

I hope in this paper to examine some of the problems that arise when we try to 'translate' works to be performed using technology available today. There are those who advocate an 'authentic' approach, painstakingly trying to use exactly the technology and performance practice of the original time. This still requires considerable 'archaeology'. However, the main thrust of my questions assumes that the contemporary performer will want to adapt the work to contemporary resources – and we must assume these will continue to evolve (there will be a life after MAX/MSP!).

2. *URTEXT(E)*

Classical music has invented the concept of *Urtext* – that is, a published version of a work purporting most closely to represent the composer's original (and assumed most authentic) intentions. The word 'text' is laden with much late twentieth century *caché* from the tradition of literary analysis. This can vary from the most iconic – treating the text as a kind of sacred object for study – to the most arbitrary, where the text is a fleeting and temporary construction. For our live electronic

[1] We should not be complacent. Stockhausen has told us that the original six-channel master tape of *Telemusik* (1966) has deteriorated and can no longer be played. No multi-channel copy of the work now exists.

Organised Sound **11**(3): 209–219 © 2006 Cambridge University Press. Printed in the United Kingdom. doi: 10.1017/S1355771806001427

https://doi.org/10.1017/S1355771806001427 Published online by Cambridge University Press

musician the text was often incomplete, annotated, sometimes rewritten for different equipment – often deliberately incomplete for purposes of spontaneity, interpretation and improvisation (in this sense, of course, not separate from many other experimental music genres of the period).

But the *Urtext* can be edited, it is not simply a transcription of the composer's first manuscript. Our editor has performance and programme notes, and most golden of all, recordings. We must not assume that composers were necessarily *happy* with all their recorded legacy (or that of others while they were alive). We must be careful to add all information sources, publications and interviews with the composer, other performers, musicologists, listeners and others.

3. AIMS

But are we aiming at 'authenticity'? Once we embark on such an enterprise, the regress is infinite. Must we demand original instruments and original performance practice on these instruments? The composer's original intentions may not be inscribed in any single document, in any medium. The same arguments apply here as in the endless debates on 'early music interpretation' – except we (may) have the recorded medium to help us.

These intentions are also not transcendental in form. We read Mozart manuscripts but not (with current traditional training) Machaut. Any score we create is a 'recreation' – an idealisation of the composer's intentions. In fact, of course, these are all questions common to editions of the Western tradition from Bach to Berg, but with all the additional archaeology more commonly found in editions of Monteverdi back through the Middle Ages to plainchant.

But what exactly are the differences between *Urtext*, *performance* and *critical* editions? In addition – learnt from ethnomusicology and, more recently, graphic transcription tools – we have the notion of *descriptive score*. This last the composer may never have seen or sanctioned, made after the event for descriptive, explanatory or analytical purposes. Self-evidently, much live electronic music of the 1960s and 1970s can only exist as documentation of the performance, being designed for specific circumstances and one-off installations. The total of such remaining documentation constitutes a descriptive score only.

But one aim here is undoubtedly both more ambitious and pragmatic – where possible to create (or allow) a *performance* edition, one with immediate possibility of interpretation. We may need to establish an *Urtext* and a critical contextual scholarship to allow this to happen, and to include all aspects of the 'trace of the work' in this enterprise.

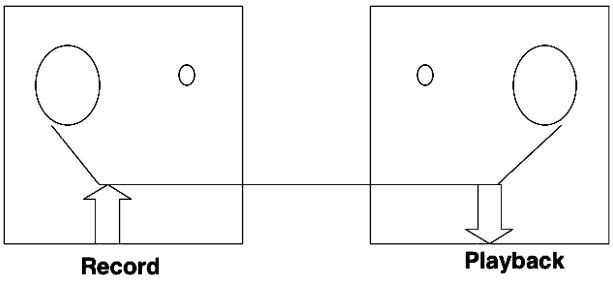


Figure 1. Tape delay.

4. CASE STUDY EXAMPLES

We need here to present some of the problems in creating a performance edition of live electronic music, highlighting those peculiar to the music typical of the 1970s. I shall examine two case study examples: Tim Souster's *Spectral* (1972) (viola and live electronics) and my own *Spirit of '76* (1976) (flute and accelerating delay). In the former I assisted in the earliest performances of the work as 'tape op' and technical assistant, although not for the composer's later recording. I also helped with a performance of its revival in 1981. For my own work I was (as far as I know) present at all, and directing all but one, of the original analogue performances from 1976–1985, and have been responsible for the new digital edition performed by three flute players since 2004.

4.1. Tape delay

To describe its most general form, a tape delay system is simply an analogue delay line in which the delay time (length of the sound recording buffer) is determined by a length of magnetic tape running between two tape heads, the first recording with the subsequent playing back. There can be more than one playback head spaced along the tape to give different delay times of the original signal.[2] In its most portable form with a single delay time, it can be constructed using two tape machines.[3] The left-hand machine is set to record, the right-hand machine is set to playback (figure 1). In addition to a one-off delay, you can feed the delayed sound back to record (via a mixer) thus creating electronic canons of what is played. In practice, tape noise build-up limits the number of such repetitions which have to be set to die away (each

[2]As in the circuit for Stockhausen's tape delay work *Solo (for melody instrument and feedback)* of 1966, realised originally at NHK (Tokyo). A 'multi-head tape delay table' with adjustable tape run lengths (= adjustable delay times) was built by Barry Anderson for West Square Ensemble realisations of *Solo* and other commissioned works (see Emmerson 1991, especially the photo in Figure 3).

[3]Strictly, *tape head echo* is a form of tape delay using only one machine: the gap between the record and playback heads constituting the delay buffer.

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re-record typically –2.5 or –3 dB down on the previous) – the better the tape machines and their maintenance, the greater the control over decay time! The actual delay time was also, of course, dependent on tape speed. Ideally faster tape speeds (typically 38 cm/s [15 ips]) were to be used, but tape lengths were then longer; however, lower speeds would result in lower quality frequency response and higher tape noise. The entire system was, of course, easily replicated in the digital age with much greater flexibility and control – though it did take the best part of the 1980s for memory to become cheap enough to construct the long delays of works such as *Solo*.[4]

5. TIM SOUSTER – *SPECTRAL* (1972)

Spectral was composed in 1972 and is scored for viola and live electronics; it was performed at concerts by Tim Souster's group Intermodulation and by the composer, solo (with technical assistants) for about the subsequent five years. It was recorded by Souster for his LP *Swit Drimz*[5] issued by Transatlantic Records in 1977. A revival (with Alex Balanescu on viola and Souster on electronics) was made in 1981 on a mix of the original with newer voltage-controlled analogue and first-generation digital equipment. A completely digital version (MAX/MSP) was directed[6] by Andrew Bentley at the Sibelius Academy in Helsinki in 2000 (the first – and so far only – one since the composer's death in 1994).

The inspiration for *Spectral* came from hearing Roger Payne's famous whale song recordings first issued on LP in 1970. Tim Souster discovered to his amazement that he could make a serious imitation of many of the whale sounds using his viola and a standard voltage pedal-controlled (low-pass) filter system in the VCS3 synthesiser.[7]

> *Spectral* is played entirely on the solo viola, the bass range of which has been extended by tuning the C-string down to G and then by transposing its sounds down further by digital means. Spectral takes as its starting-point the song of the hump-backed whale, of which the opening ARIA is an exact transcription. The subsequent sections are developments of its individual elements. The tape echoes were suggested by the whale's submarine acoustic environment in which its melancholy tones rebound alternately off the sea-bed and the surface as they die away. The title *Spectral* relates not only to the sound/colour spectrum used in the music, but also to the ghostly character of the song in which the whale seems to be singing of its own passing. (*Spectral* – programme note in the score)

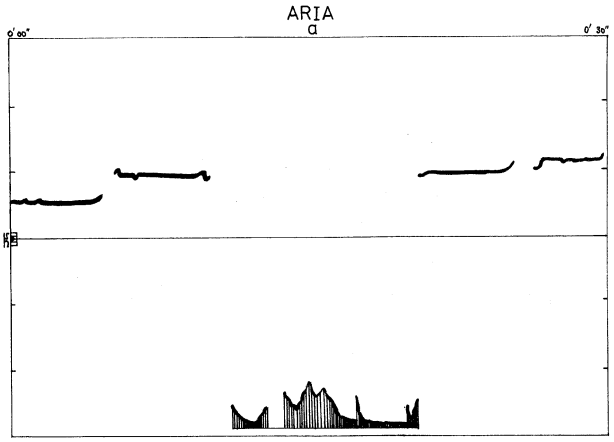


Figure 2. *Spectral* graphic notation (whale song 'Aria') (1972 score).

While the notation of the 'Aria' section is graphic, as noted in this quote it is in no sense improvisatory and the composer suggests listening to the original recordings as model. Later sections (known as 'Echoes') have greater interpretative freedom. In these, '[t]he exact pitching and timing of the individual sounds is left to the performer's discretion and to his ability to react creatively to the sound produced by the tape delay system during the performance' (score notes). Two versions of the score exist. The fully published version (which is still available) was originally published in 1982, but recent copies have an additional editorial note[8] dated 1999 (Souster 1982), and a 'reduction' made for the LP cover (1977). This latter version is indeed a complete score and is almost performable except for a lack of detail in the circuit and how to interpret the electronics.

Figures 2 and 3 contrast the two versions of the whale song transcription (figure 3 is at twice the timescale, the equivalent of two pages of the original score are shown).[9] The originals are both in colour (which cannot be reproduced here). The colours yellow, orange, red, purple, blue and green are used to embolden the graphic viola pitch line and directly represent six degrees of low-pass filtering, yellow the 'brightest' to green the 'darkest'

[4]Creating longer delays using analogue tape cost nothing – although logistical problems of machine mechanics and tape tension had to be overcome, not to speak of space on the performance stage!

[5]Phonetic transcription of 'sweet dreams', the LP included a computer realisation of an extract of Keats's poem *Endymion*.

[6]Performed by Max Savikangas (viola) with MAX/MSP programming by Mika Kuuskankare (Bentley, personal communication 2005). The patch is in the personal collection of the programmer which illustrates a point I shall make below.

[7]Made by EMS Ltd (UK), the VCS3 and its suitcase version the Synthi A were staples of many European improvisation and live electronics performers of the 1970s. Intermodulation took delivery of some of the earliest in 1969.

[8]Souster's *0dB Editions* is still run by Penny Souster (Cambridge, UK) from whom his scores are available. The note of 1999 states optimistically: 'It would be quite feasible to reconstruct the original intentions of the composer and the composition by means of present-day technology'. The score copyright is still given as '1982'.

[9]The whole score on the LP cover is a complete window mosaic on the outer sleeve folded out to 'two LP' size.

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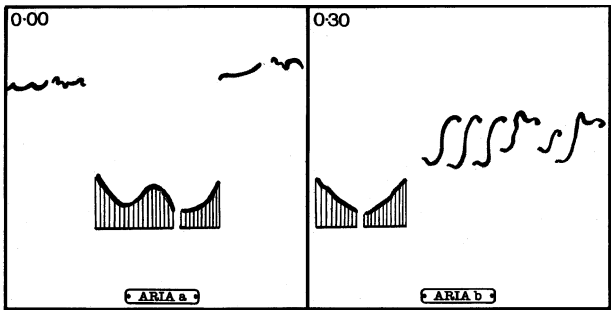


Figure 3. *Spectral* graphic notation (whale song 'Aria') (1977 LP sleeve).

sound spectrum.[10] The vertical striations beneath the graphic pitch line indicate tremolando, unbroken lines imply arco legato.

Figures 4 and 5 give examples of the 'extended traditional' notation also incorporated into the score. This greater exactitude (in traditional terms) applies to three sections only, called *Echo IV*, *Echo V* and the final *Decay*. The LP cover version of *Echo IV* is inevitably simplified, omitting detail of the other performers' actions on the additional VCS3 synthesizers.[11] These are graphic representations indicating manipulation of filtering (F), ring modulation (RM), envelope shaping (E) and panning (P). The score notes refer to 'separate instruction sheets and patch sheets showing the various synthesiser circuits' which are not included in the score itself.

Figures 6 and 7 show the diagramatic circuit from the LP sleeve (note the viola player as 'whale'!) and the more detailed published score version with notes (although still with no internal VCS3 patch detail).

Figure 8 shows the ideal layout and lighting instructions. The scene slowly changes through the colour spectrum (yellow to green – as with the filter score notation); in the final section ('Decay') there is intended to be a strobe light exactly synchronised with the envelope shaping of the viola sound. The composer did not in practice demand this aspect of the work at each performance.

6. SIMON EMMERSON – *SPIRIT OF '76* (1976)

My work *Spirit of '76* (for flute and accelerating tape delay) was written in 1976 for the US bicentennial for the American flautist (resident in the UK) Kathryn Lukas. It was first performed at an *Option Band*[12] concert at the Institute of Contemporary Arts, London on 3 October of that year. It was regularly performed by Kate Lukas and another American flautist (resident in the UK), Nancy Ruffer, from 1976–1983, with a final analogue performance by Simon Desorgher (with Lawrence Casserley, electronics) in 1985. No professional recording was released, although informal recordings of many of the performances were made by the composer.[13]

6.1. 'Accelerating tape delay'

My first statement seems impossible. An accelerating tape delay is built exactly as the basic tape delay *but* the right hand machine has a varispeed control set (for this work) to playback '3/4 tone' higher (= faster). How can this be with a fixed length of tape between the two machines? – the tape would surely break or stretch. But here an initial length of tape 64″ long loops out from between the two machines across the performance space around an empty plastic tape spool (free to slide across the floor, acting as ballast and a bit of resistance which accurate tape deck transports require) (figure 9). This loop is thus progressively 'eaten away' in the course of the work. The ballast spool is slowly dragged towards the tape machines; at a crucial moment when it arrives right by the machines, the operator deftly unhooks the still moving tape, being careful not to impede its flow in any way. The reduction process continues and the work concludes abruptly as the tape reaches direct taughtness between the two tape machines – this is set to be a 4″ delay time. With accurate machines this process takes an absolute length of time, calculable and fixed (12′03″ to be precise).

The process is thus simply a slow and continuous reduction of the delay from 64″ to 4″ with each repeated sound being 3/4 tone higher (and correspondingly shorter). Ideally there should be eight perceivable repetitions (decaying away) which would be an octave transposition (8 × 3/4 tone) in all. The feedback is set to 'ping-pong' delay with left playback fed to right record and vice versa.

7. *SPIRIT OF '76* – PSYCHOACOUSTICS AND PSYCHOLOGY OF PERFORMANCE

The piece is composed to go from very quiet, low and sparse sounds to very loud, high and dense textures. This process is reinforced and multiplied on the delays resulting in an exponential increase in density, dynamic, tessitura and hence intensity over the course of the work. Most notably, sum and difference tones are

[10]All the wordplays on the term *spectral* were intended – including the 'ghostly' (see quote above).

[11]The *Decay* movement is shown in figure 5; the full score version (not shown) is little different, writing out the rhythms more fully. No further live electronic detail is added.

[12]Option Band was a UK contemporary music ensemble directed by Lise-Martine Jeanneret, active from the mid-1970s to the mid-1980s. The author was the member responsible for electronics.

[13]Interestingly the tape which ran on the machines to make the tape delay was an accurate 'record' of the performance without room ambience and in hard 'ping-pong' stereo with the player on the left!

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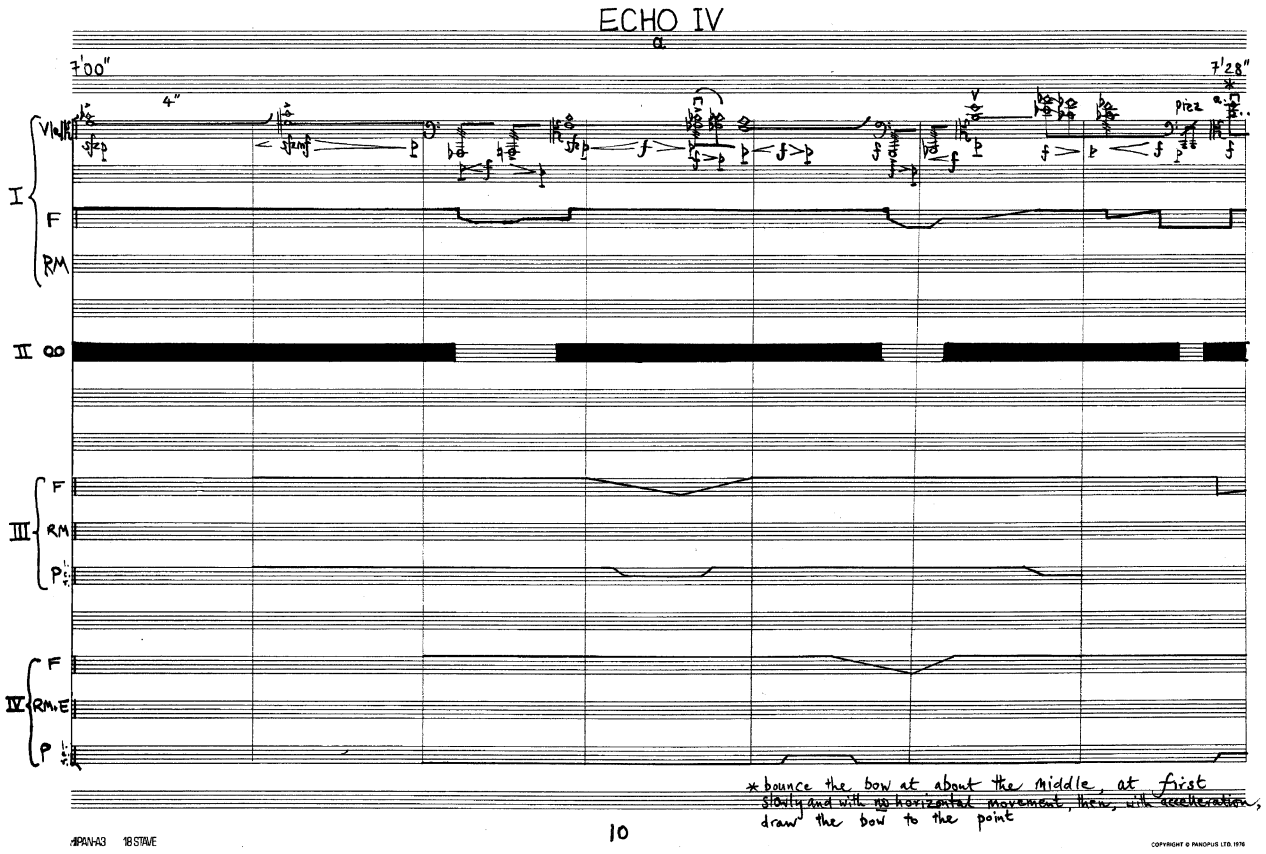


Figure 4. *Spectral* extended traditional notation (1972 score).

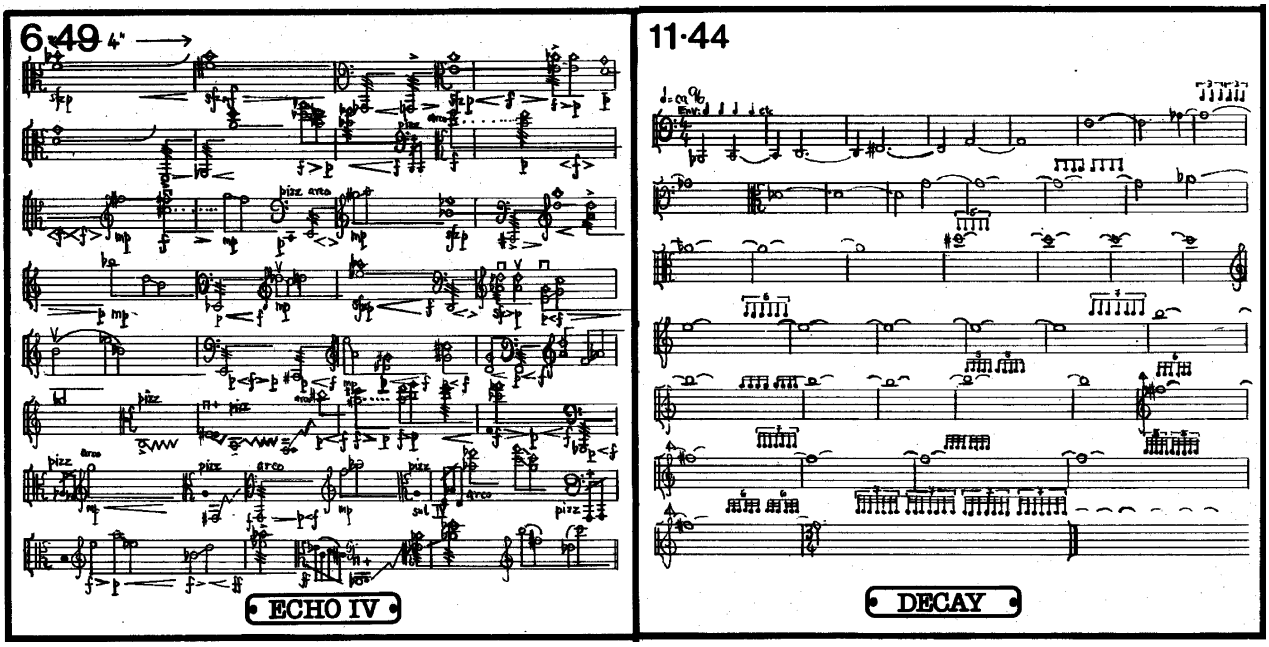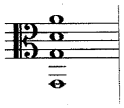


Figure 5. *Spectral* extended traditional notation (1977 LP sleeve).
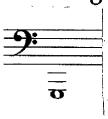
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2 Circuit
See diagram.

A viola, fitted with a contact-microphone or, better, a magnetic pickup, is connected to a device, controlled by a foot-pedal, whereby the frequencies of the two lower strings may be halved, i.e. their pitches are automatically transposed down one octave. The tuning of the open strings of the viola in **Spectral** is:



which means that, when the frequency divider (FD) is activated by means of the pedal, the bottom note of the viola's range (as heard through the loud-speaker) is:



When the FD is not engaged, the frequency of all the strings of the viola remain unchanged.

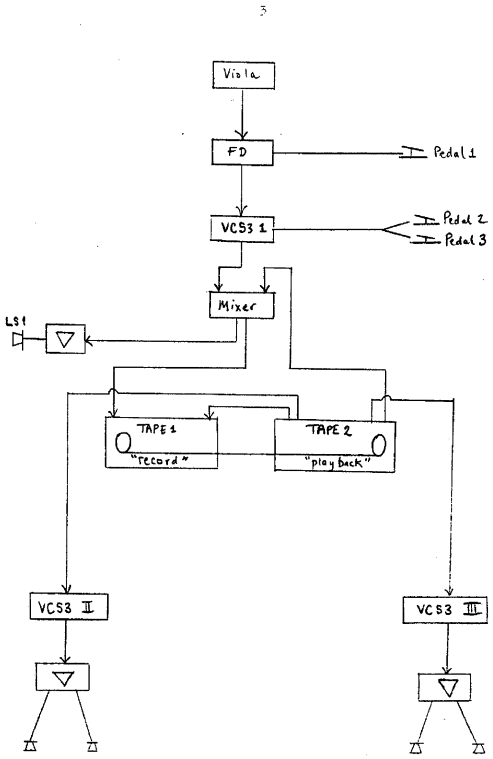


Figure 6. *Spectral* circuit (1972 score).

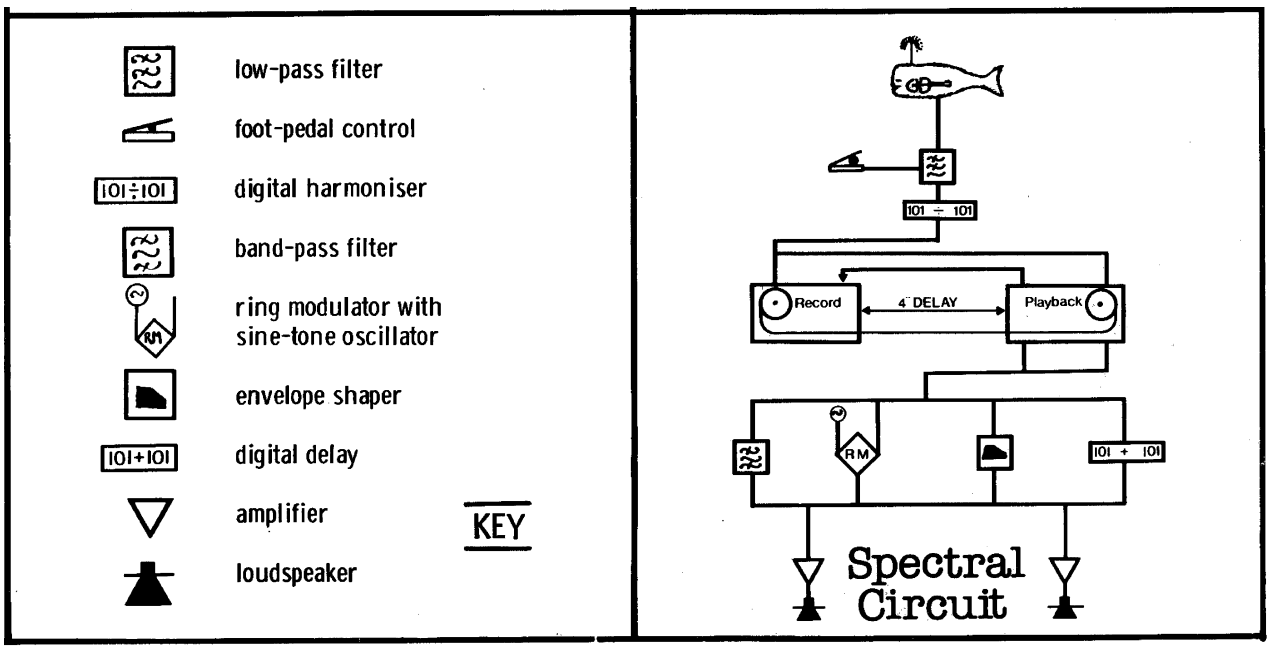
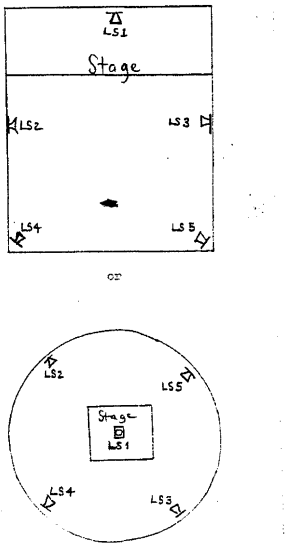


Figure 7. *Spectral* circuit (1977 LP sleeve).

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3 Layout
Either layout below is possible. In both kinds of hall, speakers 2-5 should be positioned high up, suspended from the ceiling, standing in a balcony etc. In the round hall, LS1 should lie on its back, the sound projected upwards and outwards in all directions.



4 Lighting
The lighting of a performance of **Spectral** is an integral part of the composition and must be executed exactly according to the time-scheme provided for the lighting technician. In **Aria** normal bright stage-lighting should be used, and in such a way that the audience should not suspect that it will change in any way. After two minutes, however, the lights fade almost imperceptibly to yellow and then with each successive section, an extremely gradual transition is made from **yellow** to **orange** to **red** to **purple** to **blue** to **green** (always moving from light to dark) which culminates, in the last 30 seconds of **Echo VI**, in complete darkness. The pulsations of **Echo VI** are linked to the flashes of a stroboscopic light which increases in speed exactly in synch with the output of LS1. The violist ceases to play at 13' 40", but the music continues on the tape-delay system until 14'30". During this time the stroboscope continues to be trained on the platform at a constant flash rate of c. 20 per second. This illuminates the movements of the violist who, after he has stopped playing, bows slowly and silently to the audience and slowly leaves the stage.

Figure 8. *Spectral* layout and lighting (1972).

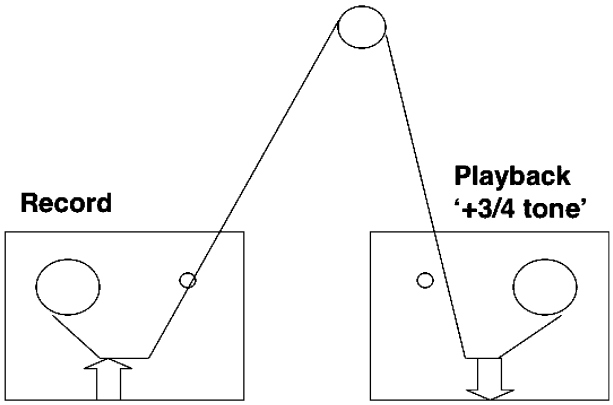


Figure 9. *Spirit of '76* 'accelerating tape delay'.

created 'live' in the room;[14] they seem to be present but 'strangely' located somewhere around your head and ears. Many of these are lower than the lowest performable note on the flute.

The visual and aural reinforce each other. The piece starts quietly and the audience follows the slow progress of the tape spool and loop across the floor. The intensity begins to rise. The psychological tension becomes almost unbearable[15] as the audience watches the tape reach physical tension and breaking point. How will the piece end? Will the tape break? The piece stops abruptly at that point. The massive high block of sound (with sum and difference tones in full flight) simply cuts off. The question is left unanswered.

7.1. Analogue-to-digital?

The piece can sonically be realised using MAX/MSP: an initially 64″ record buffer is read back with steadily decreasing delay time, resulting in the necessary time and pitch transposition, exactly as in 1976. However, the essential theatrical dimension of the accelerating tape delay will have disappeared. A digital system on laptop will produce the same *sounds* (except without all that analogue noise) but not the same *performance experience*. For those who believe the music is in the sound alone (and how you get there is irrelevant) this is not a problem; but I adhere to the broader view of the music as lived and shared social experience, hence a new MAX/MSP version is essentially a different piece.

[14]And would be perceived in your living room from a broadcast or recording.

[15]In some performances there were unintentional moments of humour – the tape ballast spool might get caught on the floor and the operator (usually the composer) had to move deftly across the space to release it. This would put a pitch 'wow' onto the recording which would be ceremoniously repeated and transposed thereafter.

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An authentic performance practice is now virtually impossible. But then it would not be authentic just because it used the 'same' machines: a tape machine for an audience of 1980 would not have the antique quality, the retro chic, of an experience of it in the twenty-first century.

7.2. Cheating . . .

An opportunity to test out the new MAX/MSP version came on being asked to curate a 'retrospective concert' (at the Sonic Arts Research Centre in Belfast) for the 25th anniversary of EMAS/Sonic Arts Network[16] in 2004.

While the MAX/MSP patch ran the 'real' sound system processing the flute sound, two (Revox) tape machines ran as originally, tape loop across the auditorium floor slowly being reduced – but in truth producing no sound.[17] We ran a video camera on the tape delay system and projected it. In conversations after the performance it became evident that rather than seeing through the irony of juxtaposing redundant tape machines against 'modern' computers, some of the audience actually believed they were hearing the original version produced by analogue means!

7.3. . . . and a postmodern compromise

This suggested a more honest alternative; some time later I videoed the process with two cameras in an empty space and edited a version to exactly the correct duration. This can now be projected to accompany a contemporary MAX/MSP performance. This functions as a kind of 'window into the past'; a pale glimpse of the original system. Is this authentic? Certainly not – but it is one possible compromise 'solution'.

8. VALUE ADDED/SUBTRACTED – THE COMPOSER'S INTENTIONS?

In translating analogue systems into contemporary digital forms there is one immediate dilemma. Dare we guess what the composer would have done with contemporary technology? And in any case, how important is the composer? The composer is both vital and yet not the sole authority on 'the work'. If a composer lives to see and hear a newer generation of technology, then s/he is available to 'update' the system. But is this always reliable? Few composers would resist the temptation to 'update' beyond merely reproducing the original on the new system; even fewer would preserve the idiosyncratic (noisy and unreliable) behaviour of the original. The boundary between editorial licence and authorial prerogative would be impossible to define. Worse, if the composer were no longer with us, exactly the same questions would exist but modified to 'would the composer have taken advantage of this new feature, improved performance, increased capability, etc.?'

Or is our job simply to recreate the original as best we can? But then again just what is 'the original'? Is it the *sound* of the original or a *performance practice*? Recreating the 'feel' of analogue gear has two components: the physical feel, the resistance of devices to physical movement, touch or pressure; secondly, the 'acoustic feel' of the relationship to the result, how the device responds to the physical input. Then what is the *authentic sound*? Should we retain the analogue noise that was present at the time or the distortion and limited frequency handling?

If the composer has intentions, so too the work itself may be said to have intentions (see footnote 8) and sometimes the two may, in time, be at odds.[18]

9. TO BE OR NOT TO BE? (ANALOGUE NOISE)

Analogue noise is a special problem with a special history. First and second generation electroacoustic composers (whether in or outside the studio) spent much time trying to minimise it. We know that digital systems can complete the job. But is our job to optimise or minimise?

To a younger generation, analogue noise has become an 'aura' of its time. Noise is something not to eliminate but to acknowledge as part and parcel of the creativity of that era. Removing it is not to be confused with cleaning a painting from *subsequent* dirt – noise was there in the original creation of the work. This view has indirect support in the variable and idiosyncratic efforts made to 'clean up' pieces for CD reissue.[19] Noise gates are a classic example – noise 'pumping' is much more noticeable than continuous noise background.

For live electronic music the dilemma lies in the performance domain; we are usually re-creating the sound *ab initio*. We would surely not deliberately create noise if not specifically part of the work's intentions.[20]

[16]The Electro-acoustic Music Association of Great Britain (EMAS) was founded in 1979 and became Sonic Arts Network in 1989.

[17]The organisers wanted an 'authentic analogue performance' which I deemed too risky, and this compromise was at the suggestion of the technical director Dave Hunt.

[18]I would suggest this is the case in a work such as Stockhausen's *Stimmung* (for six amplified vocalists) (1967). Published originally as a mobile score for multiple versions created by the performers (UE 14805 published in 1969), it is now republished as a fixed score with all variable formal options removed ('Paris version' UE 14737 – still copyright dated 1969 but referring in the notes to performances up to 1981).

[19]CD re-issues of Stockhausen's *Studie II* (Stockhausen 1991) and (one version of) Berio's *Omaggio a Joyce* (Berio 1998) have evidently been treated in such a manner to the detriment of the work (in the author's opinion).

[20]My personal view on the noise issue is that it should never deliberately be added in as a part of a spurious 'authentic sound'. If however it is present in the use (once again) of analogue circuitry then that would be a different matter.

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10. IS A 'LIMIT' A 'LIMITATION'?

There is a nuance here – a 'limit' has the implication of a boundary beyond which you do not (or cannot) move, while a 'limitation' implies that there is frustration that the system cannot allow this further movement (in pursuit of some aim). All systems have limits;[21] to what extent these are limitations may not immediately be apparent. 'Struggling against limits' is a branch of performance practice very explicit in the history of Western performance virtuosity, at least since the late classical period and now true in popular music developments, too. But strictly you only know *to what extent the limits were limitations* at a later date when many have been removed and the system 'improved'. The word 'limitation' is, of course, not always favoured by 'authentic movement' performers who see (say) baroque instruments as 'different' rather than 'more limited' than their later counterparts. But for the performers of the emerging romantic era this was clearly not so in their demand for changes in instrument construction enabled by the new technology of that period. *We* might miss the expressive timbral irregularities of the baroque flute or pre-valve horn but *they* clearly did not.

Analogue synthesiser circuits and their irregular behaviour took on the nature of 'irritating but close friends' to their performers. There are two components here: *limited sound fidelity* and *unreliability*.

Analogue noise had several origins. In addition to tape noise (caused by random magnetic particles), circuits themselves inevitably produce noise due to electron movement (theoretically reduced as one approaches absolute zero of temperature!). Then there was distortion – sometimes circuits were simply non-linear in transfer of voltages, and in addition anything which crossed the limited *dynamic range* of the unit would distort. In signal processing only the final decade of analogue devices could handle what we would now hear as 'CD quality' frequency range (and in fact bass frequencies were as difficult to handle faithfully in analogue as high treble). What do we do now we have such handling capability – reproduce the *sound* or assume the composer 'would have wanted' this improved (so-called) quality?

Then we had the unreliability. Electronic oscillators would drift – depending on the temperature of their components and their surroundings amongst other things. Tuning was thus a risky business conducted shortly before performance and sometimes unreliable during it. This was compounded by the fact that in addition *control* voltages would drift. In fact stability did improve substantially in the twenty-five years or so of the analogue synthesizer, especially after the introduction of small digital control devices within predominantly analogue systems (so-called 'hybrid' systems).

We won't add these 'limitations' back in? *Will we?!* Actually nothing can be taken for granted. There may be two approaches – *simulation* and *re-creation*.

11. RETRO

We might be able to build these endearing idiosyncracies to newer models (simulations) of old devices. The software would have to mimic drift, error, noise and distortion[22] as discussed above and deliberately limit fidelity in a manner indistinguishable from the original analogue circuits. This might in turn be related to the creation of retro-interfaces which *feel* like those of the Moog, Buchla, Arp, VCS3, etc. – indeed they could be reproductions behind which the new technology operated.

Then again (as in the 'rediscovery' of early instrument production in the last half of the twentieth century) we should not rule out the simple possibility that a future generation of music technologists will *relearn how to build the exact circuits*. A generation of specialist suppliers (who might use the most advanced methods actually to construct these 'ancient' circuits) can easily be supported by demand – especially in the emerging 'customisation culture'. Why not simply *re-create* the original?[23]

We must leave this speculative discussion to return to the more pressing question of the *trace* that might be left by live electronic works for such a future generation to perform – authentically or not. It is painfully obvious that the ideals outlined below cannot always be met.

12. SHORT-TERM PRAGMATICS: A *LIVE ELECTRONIC* ARCHIVE

Let us construct an ideal *archive* of live electronic materials for the future user. I am going to assume that such an archive will be used for both study and practical applications. It should be not just a historical repository but a source of creative material for performance (and the stimulation of new work).

Such an archive needs three components:

(1) *Urtext materials*. The problematics of these have been introduced above. The concept of *Urtext* is open and provisional. While the basics must be assembled quickly, it may evolve and expand with materials added in the future. The best we can do is to assemble all traces of the work at one location (real or imaginary). This to include all

[21]Even if strictly a product of human imagination rather than physical boundary.

[22]But please not the unreliable connections.

[23]EMS and most other analogue synthesizers are still maintainable through specialist engineers – but these do tend to be people who were 'there at the outset'.

https://doi.org/10.1017/S1355771806001427 Published online by Cambridge University Press

score materials in the traditional sense, other performance materials and notes, electronic patch details, recorded performances, photographic materials, programmes, reviews. Ideally also materials of prior activities, sketches and links to previous and later works involving similar resources (some by other composers).

(2) *'Generic score' materials*. The idea of a 'generic score' is an ideal but let us try to describe its characteristics. I am not arguing that 'the work' exists as an absolute abstraction,[24] but I would suggest that the score of many works can be 'generalised' in a manner *not specific to any particular technology – most obviously that upon which it was created*. Many composers have tried to do this over the years, but it becomes clear from the scores of works such as the two examined here, how limited this was. We need clear descriptions of circuit function and behaviour, backed up by recordings (and videos). The degree of detail will be difficult to define *a priori*. The specific characteristics of Souster's *Spectral* circuit were relatively easy to decode to MAX/MSP but we may become fussier about timbral nuance (in which *some but not all* of the idiosyncratic behaviours noted above may play a part). Ideally the composer should prepare such a score in parallel with one specific to the technology at the time of composition.[25] This should be built into contemporary pedagogic programmes. The generic score can be fixed from the *Urtext* – it may evolve but less so than the others.

(3) *Performance score materials*. Finally we have the performance score which allows an immediate contemporary performance of the work. Strictly this is transient and evolutionary. It is based most clearly on the generic score (no doubt referring in practice to all available *Urtext* materials as well). Versions of it would be created for the specific technological resources available at the time. These can vary from place to place as well as time to time – although these distinctions may reduce (even dissolve) with Internet interactivity providing a possible 'universal availability' of this function in real time.

If we say much of this needs to be done 'quickly', this is a euphemism for 'before it's too late'! The performance tradition for which Mozart wrote did not die with him (although it was in a process of rapid change), but with much experimental contemporary music of the 1960s and 1970s the 'performance tradition' was local and even personal.[26] While recording can make up some of the loss, there is a need to include much greater information on performance practice taken for granted in previous generations.

13. GENERIC SCORE: MORE DETAIL

The generic score is the greatest problem in this archive. In many revivals such a score exists but fleetingly and may become 'lost' (or at least not freely available).[27] It often does not belong to the composer but to a local enthusiast organiser or performer who has created it on the way to the specific performance score for the occasion of a revival using different technology.

We need detailed annotated versions of the original circuit diagrams. We forget how much knowledge is assumed in the signs and symbols used. We need *process descriptions* with details of limits, ranges and initial settings. These may not only be in the numerical forms encouraged by the manufacturer but might include sound recordings as direct illustrations (words are self-evidently inadequate). The elusive 'idiosyncracies and characteristics' (at least those believed to be essential to the original sound) can probably only be 'described' in sound. Finally, control interface generic descriptions are needed. These may be more problematic, but ideally should include diagrams with switch and control *types*, potentiometer ranges, limits and settings. (As noted above – it will be much easier to mimic *sound* than physical performance devices. Software is already available to mimic the sound of many analogue synthesizers.)

The archive has a pedagogic function. It seems evident to me that the MAX/MSP generation is making the same mistakes as the Moog-Arp-EMS one. A patch may work without any accompanying explanation of its structure and functions. Of course this is not needed for today's performance but may be vital for tomorrow's revival.

Ideally composers themselves should produce these scores. But the knowledge and skill needed cannot be taken for granted. Composers most often work directly with the technology available – not a reified generic abstraction of its possibilities. Composers produce concrete circuit diagrams anchored in the technology they have to hand. The faster that technology changes the shorter the life of their creation.[28] I am well aware that not all composers want to idealise their work for

[24]In the sense of the German tradition following Hegel and Schopenhauer.

[25]One hopes that future developments will allow MAX/MSP patches to be 're-read' into newer software or the cycle will be set to run again!

[26]In common across all eras is the 'taking for granted' of many aspects of interpretation, from baroque ornaments to graphic notation, scores are *essentially* incomplete determinants of the performance.

[27]It may (bizarrely) even deliberately be concealed if the work is published.

[28]An exception effectively proves the rule. Stockhausen's approved performances of *Mantra* (1970) still demand the original purpose-built ring modulators of which only a limited number are still available for expensive hire.

https://doi.org/10.1017/S1355771806001427 Published online by Cambridge University Press

further performance in an unpredictable future. It is perfectly valid to see the work as time-stamped and limited in performance longevity (that may yet turn out to be a healthier view!).

14. BALANCING STANDARDISATION AND INNOVATION

The vexed question of standardisation will also have to be addressed. Clear communication involves a degree of standardisation – of signs and symbols on the one hand and of formats, layouts and 'completeness' of descriptions on the other. But live electronics has been a real inventor of *new notations*. The Souster work used here is an excellent example: it is not a model to be copied but an inspiration for further innovation. It is clear, concise and apposite to the specific task of the work. Only the *essence* of the unique and appropriate (not its form), is transferable to other works. We must be clear to back up such originality in scoring with description and recording as appropriate.

However, technology is another matter: tentative standards of symbology have been established for most analogue signal processing devices (amplifiers, microphones, filters, oscillators, etc.), but more complex digital processes often lack an equivalent. 'Event processing' modules may indeed be too varied to allow any standard symbology to emerge. But code itself is a form of symbolisation and can be said to be its own description (for an initiated few programmers). The reduction of this complexity to understandable generic format for the future might involve 'intelligent agents' – indeed in the long run the entire generic score creation might possibly be automated with such assistance.

We must be careful not to let such an archive become an 'authority' defining *a priori* how things should be notated. The history of Western music has been littered with misunderstood borderlines between description (how things have been composed) and prescription (how things should be composed).[29]

15. MUSIC EXAMPLES

There are two examples on this year's Organised Sound DVD. The first places in sequence three extracts from the composer's performance of *Spectral*: the opening of 'Aria', the opening of 'Echo IV' and a section from 'Decay' (all to be found in figures 2–5); the second sequences extracts from earlier and later parts of *Spirit of '76* (an early analogue performance) along with extracts in sequence from the composer's video of the tape process – the audio and video are not synchronised except at the end to show the 'instant cut off' of the sound.

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[29]A paradigm example: A. B. Marx's 'invention' of sonata form in 1845 well after the end of the classical era.

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